PATENT SPECIFICATION

718,535

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COMPLETE SPECIFICATION

Improvements in Colour Lighting Control Systems

I, ROLLO GILLESPIE WILLIAMS, of 20, Clent Road, Great Neck, Long Island, New York, United States of America, a British Subject, do hereby declare the invention for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to colour lighting control systems and particularly to a system for the production of light of a desired hue of colour by combining colours of illumination from electrical sources of coloured light, the system being characterised by a method and arrangement for connecting selected light sources at will in different ways across a source of voltage, to produce different desired hues of colour, without the need for using an external resistance. A preferred method and arrangement is one in which the intensity of light from a selected source of coloured light required for the creation of illumination of the desired hue of colour can be in part controlled by the resistance of another light source which produces no perceptible illumination when thus utilised.

In the control of lighting systems for theatres, store windows, and other places where light, and particularly coloured light, is essential, it has been customary heretofore to use dimmers to control the voltage applied to the several sources of light and thereby to adjust the light values of the several sources of colour. It is well known that dimmers represent a considerable item of expense in the construction of lighting control systems of the purposes above stated. I have found that it is possible to obtain a wide range of hues of colour of light by combining the light from selected sources of coloured light and simultaneously controlling the magnitudes of the voltages across those selected sources by arranging them in a network across a supply circuit, the network embracing those sources of colour that enter into the production of the desired hue of colour and also other sources of colour, the said other sources of colour serving merely as control members to adjust the voltages across the sources of colour that enter into the production of the desired hue so that the latter sources will produce light in the various proportions required for the creation of a light mixture of the desired hue of colour.

Another feature of this invention resides in the selection of electrical sources of coloured light by means of cam-controlled microswitches or other convenient type of two-position switch and connecting the selected sources to a source of voltage, the switching arrangement being such that the voltage applied to the sources may be either the full line voltage or fractions thereof, the reduction in voltage being effected by connecting desired sources in a network across a supply circuit and by utilizing the resistance property of certain of the light sources to control the voltages across other light sources whose luminosity at predetermined light values is essential to the production of a desired hue of colour.

The invention will be clearly understood from the following description when read in connection with the drawings in which:—

Figure 1 is a circuit diagram showing a simple form of embodiment of the invention.

Figure 2 is a circuit diagram showing a form of the invention in which each colour is provided by two electrical sources of light with switching means by which the sources may be connected in series or parallel with each other and the range of control further extended.

Figure 3 is a circuit diagram in which the white lamps only are arranged to be connected in either series or parallel with each other the other lamps being arranged permanently in parallel with each other.

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be seen that with the contactors of switches 10 and 11 upon contacts 10a and 11a, and with the contactors of auxiliary switches 20 and 21 upon contacts 20a and 21a, the lamps R and R1 will be connected in parallel across the line L. When the contactors of switches 20 and 21 are moved to contacts 20b and 21b, the lamps R and R1 will then be connected in series across the line. The ability to connect both lamps of the same colour in series or in parallel with each other, combined with the ability to connect the pairs of lamps of different colours in series, or parallel, or series-parallel, greatly increases the range of steps of lighting intensity of the circuit of Figure 2, and, in consequence, increases the colour range of the light sources of the circuit.

However, it is not necessary to provide for the connection of all pairs of sources of colours in series or parallel as shown in Figure 2. Extremely satisfactory colour results are attainable by a circuit such as that shown in Figure 3 in which the lamps of each of the pairs, red, green, and blue, are permanently connected in parallel, and only the white lamps are arranged for connection in series or in parallel with each other as desired. The wide range of hues of colour attainable by variations of the circuit shown on Figure 3 is indicated upon the chart, Figure 9. Referring to that figure (which shows the operating conditions of the circuit of Figure 3 to create the colours there shown) it will be seen that in order to produce the hue of colour designated " cerise " the contactors of switches 30, 33, 34, 35, and 37, are allowed to remain in the positions shown in Figure 3, but the contactors of switches 31, 32, 36, 38 and 39 (the latter two being coupled together) are moved to the opposite positions. As the result of that setting of the switches, an electrical network is formed in which the pair of red lamps, which are in parallel, are connected in series with the pair of green lamps which are in parallel, the pair of green lamps being shunted by the two white lamps which are in series with each other, the entire network being connected between the hot side and the neutral side of the line; the pair of blue lamps in parallel is connected across the line. The voltages across the pairs of red, green and white lamps, as connected in the network just described, will be as follows: red, 75 volts; green, 43 volts; and across each of the white lamps, 21.5 volts. Each of the pair of blue lamps receives the full voltage of 118 volts from the line. The light intensity of the white sources of light behind the red, green, and blue filters resulting from those voltages are as shown in the next column of the chart, Figure 9, the blue light being at full intensity, red at 20 percent, and green at 1.2 percent of full brightness. The white lamps, viz., those without colour filters, make no contribution to the illumination —they serve merely as resistance elements. Their importance in this particular combination resides in influencing or contributing to the adjustment of the voltage of those lamps whose luminosity enters into the creation of the mixture of light having the desired hue of coloured light. If the white lamps have not been employed in the network to shunt the green lamps in the manner indicated for colour No. 3 in the chart, Figure 9, the voltages across red and green would then have been evenly divided, i.e., 59 volts across each, and the resultant colour would then be " deep cerise " which is colour No. 2 in the said colour chart.

The transition from " bluish green " to " torquoise " (colours No. 28 to No. 30), affords another illustration of the manner in which the hue of colour of the light mixture may be varied by using certain lamps as voltage control elements and not as sources of illumination. To produce " bluish green ", the switches are set so that the pair of green lamps, in parallel, is connected directly across the line and the pair of red lamps in series with the pair of blue lamps are connected across the line in a series-parallel arrangement; the white lamps are disconnected from the line. If the switch 36 is left in its normal position as shown in the figure, instead of being moved to its opposite position as in the production of " bluish green ", the pair of red lamps which was in series with the pair of blue lamps across the line will be shunted by the two white lamps, in series and the magnitudes of the voltages of the several lamps will be changed from what they were in the creation of " bluish green "—red decreasing from 59 to 43 volts, blue increasing from 59 to 75 volts green remaining unchanged at full voltage, and each white lamp receives 21.5 volts. Viewed from the standpoint of light intensity (Figure 9), red has dropped from 7 to 1.2 percent, green remains at 100 percent, and blue has increased from 7 to 20 percent; white produces no luminous effect. The resulting colour, No. 29 on the chart, is " peacock ". The hue of colour may be again changed by switching the white lamps into parallel relationship by restoring switches 38 and 39 to normal and leaving all other switches as they were for the production of " peacock ".

Upon referring to the chart, Figure 9, it will be seen that the voltage of red is further reduced, falling to 25 volts, blue is further increased, rising to 92 volts, white is increased slightly, to 26 volts, and green remains at maximum voltage. Red and white have no perceptible effect upon the hue of colour of the light mixture; that being entirely the result of green and blue; the resulting hue is color No. 30, viz., " deep turquoise ".

To create those networks and to vary the connections to produce desired colours, the microswitches may, of course, be manipulated by hand, each being moved to the position indicated by the chart, Figure 9, to establish the circuit connections for the production of a desired colour. Such an arrangement would be laborious and open to the possibility of error in selection. To avoid that, an arrangement such as that shown in Figure 4 may be used. That arrangement employs a plurality of cams, 40 to 48, inclusive, each of which coacts with a rider fastened to the contactor of one of the microswitches, 30 to 38, inclusive, so as to cause the contactor to make contact with one or the other of the contact points, depending upon the contour of the cam. Cams 46 and 47 control the operation of switches 36 and 37, the contactors of which are connected to the auxiliary switches 38 and 39 in the manner shown in Figure 3. The contactors 61 and 62 of both of the latter switches are strapped together as there indicated and controlled by a single cam, as 48, so as to effect either series or parallel connections of the white lamps as desired. The cams may be on the same shaft, as shown in Figure 4, or they may be grouped upon different shafts which would be geared together so that all cams will be under a single control. That control has a dial associated therewith upon which is indicated the colours that will result from the settings of the cams. If desired, the shaft 49 may be rotated continuously by a motor connected therewith, which would result in the continuous production by the lamps controlled thereby of the entire range of hues of colour shown on the chart, Figure 9. Means may also be provided for intermittent operation of the apparatus so that each hue of colour will be displayed throughout a given length of time, such timing means being well known in the art.

Some of the various forms of embodiment of the invention are shown in Figures 5 and 7, inclusive. In Figure 5 the control apparatus 53 (shown in enlarged form in Figure 8) which contains the cams and microswitches such as those shown in Figure 4, is connected by a cable 54 with a lighting strip 55 which contains the white light sources and the filters by which the various colours of light there indicated may be produced. Although Figure 5 shows but a single light source for each colour, it is to be understood that in practice there could be a greater number of sources for each colour. Figure 6 shows the application of the invention to a spot-light 56. In this arrangement the control apparatus 57 is integrally connected with the structure of the spot-light. It is to be understood, of course that the sources of light in Figure 6 may be connected to the microswitches of the control apparatus 57 in the manner shown, for example, in Figure 4. The arrangement shown in Figures 5 and 6 lend themselves best to the production of colour lighting in theatres, store windows and other places of a public or commercial type, but the invention is not limited to such use. It is often desired to have coloured lighting in residential rooms the colour of which may be changed at will from time to time. The lighting arrangement shown in Figure 7 is designed to meet this need. The arrangement there shown is a table lamp which has in the upper portion thereof a plurality of colour filters suitably supported by the framework of the lamp. Beneath the filters are sources of white light suitably also supported by the framework of the lamp, the sources being positioned beneath the filters. The means for supporting the filters within the shade would be arranged to reflect downward white light that does not pass through the filters. A shade 63 suitably supported by the framework, or otherwise, would be provided. With that arrangement the coloured illumination will be projected upward to the ceiling of the room and the white light will be projected downward. By means of a switch 60 located upon the base 59 of the lamp, the setting of the microswitches may be adjusted at will to select the desired lamp and connect them in a network so as to produce desired hues of colour of illumination upon the ceiling of the room. At the same time white light will be projected downward for reading or other purposes. The microswitches and the cams necessary to control the coloured lamps may be placed in the vertical standard or post 58 of the lamp by suitably proportioning it to contain such switches, or they may be located in the base 59 of the lamp. It is to be understood, of course, that the invention may be embodied in a floor lamp or in any type of fixture where it is desired to project

coloured light upward and at the same time to have a controlled amount of light projected downward, the latter being optional.

It should also be understood that while the colours red, green, blue, and white, have been mentioned in describing the invention, other hues of colour may be employed, if desired, to obtain other colour effects without in any way departing from the scope of the invention. Obviously, the change in the colours employed produces no change in the fundamental principle of the invention, namely, the utilization of certain selected sources of colour merely as resistance elements to contribute to the adjustment of voltage across other selected sources of colour that enter into the creation of a light mixture of the desired hue, the arrangement effecting voltage control of the sources of colour that heretofore was attainable only by the use of a dimmer. This is clearly shown by the colour chart, Figure 9. Referring to that chart it will be seen that thirtythree distinct hues of coloured light may be created by selecting and combining the light from only four sources, red, green, blue, and white, certain of the selected sources of colour contributing merely to the control of the light value of other colours that combine to form the desired hue of colour.

Further gradation in resistance values may be obtained by extending the principle embodied in the control circuit of the white lamps W and W1 shown in Figure 3, to a circuit embodying two pairs of white lamps, each pair of which would be arranged in a subsidiary circuit precisely like that shown in Figure 3 between the points *a* and *b*; that is to say, each of those subsidiary circuits will contain a pair of white lamps W and W1, W2 and W3, and each pair would be connected to a pair of coupled microswitches such as 38 and 39. Those subsidiary circuits would not be connected directly to the contactors of switches 36 and 37 as is the circuit of the white lamps shown in Figure 3. The connection of the subsidiary circuits to switches 36 and 37 would be through the circuit shown in Figure 3 from which the white lamps are removed, leaving only the microswitches 38 and 39; that is to say, the circuit shown in Figure 3 in which the connection between the point *a* and the contactor of switch 39 (including the lamp W1) would be removed and also the connection between the point *b* and the contactor of switch 38 (including the lamp W) would also be removed. Then, one of the subsidiary white circuits would be connected between the point *a* and the contactor of switch 39 and the other subsidiary white circuit would be connected between the point *b* and the contactor of switch 38. The circuit of the white lamps W, W1, W2 and W3 would then include the two subsidiary circuits each containing a pair of lamps and an intermediate connecting circuit bridged across the contactors of switches 36 and 37 and containing only switches 38 and 39. With the switches 36, 37, 38 and 39 in the positions shown in the drawing, each pair of white lamps would be connected across the supply circuit either in series or parallel depending upon the position of the coupled contactors of the switches in the subsidiary circuits. By moving the contactors of switches 38 and 39 to their opposite positions, the pairs of lamps W and W1, W2 and W3 will be connected in series across the supply circuit. By further manipulation of the coupled switches of the subsidiary circuits, the arrangement of the white lamps in the network may be further varied, which will afford greater gradation of resistance values. By increasing the number of subsidiary circuits each containing a pair of lamps and switches, the gradations of resistance may be increased until they closely approach that afforded by a dimmer.

While the invention has been disclosed as embodied in particular forms, it is to be understood that it is capable of embodiment in other forms without departing from the spirit and scope of the appended claims.

What I claim is:—

1. In a colour lighting system for the production of a desired hue of colour by combining light from a plurality of electrical sources of light of different colours, the method of selective energisation of the light sources in which at least three lamps comprised in the light sources are permitted to be connected at will alternatively in series or parallel or series parallel arrangement across a source of voltage thereby utilising the resistance of one or more lamps in place of an external resistance for varying the intensity of illumination of another lamp.

2. The method according to Claim 1 wherein the lamps are permitted to be connected in such manner that the voltage applied to a lamp used to produce the desired hue of colour is controlled by the electrical resistance of a lamp not used to produce such hue.

3. A colour lighting system in which a selected hue of colour is adapted to be produced by combining light from a plurality of electrical sources of light of different colours and by controlling the

relative luminosities of such light sources, comprising the combination with said light sources of switching means for varying their selective energisation and relative luminosities, said switching means being operable to connect selected light sources in a plurality of ways in which the electrical resistance of one light source is used to control the voltage applied to another light source.

4. A colour lighting system adapted to produce a desired hue of coloured light by merging illumination from selected electrical sources of light of different colours comprising at least three sources of light each differing in colour from the others and switching means operable to connect selected ones of said light sources collectively across a source of voltage, the arrangement being such that in at least one setting of the switching means the electrical resistance of one selected light source not used in the production of the desired hue of colour is utilised to control the voltage applied to another selected light source the luminosity of which is to be used for creation of the desired hue of colour.

5. A system according to Claim 3 or Claim 4 wherein the connection of the light sources to select a desired hue of colour is effected by adjustment of a common controlling means.

6. A system according to Claim 3 or Claim 4 comprising two-way switches associated respectively with the said light sources, each switch being operable to connect its associated light source either directly across the source of voltage or in circuit with another light source.

7. A system according to Claim 6 having a pair of two-way switches associated with each light source and having each light source connected between movable contact members of its associated pair of switches and having a fixed contact of each switch in a pair connected to a common conductor and the remaining fixed contacts of such a pair of switches connected respectively to two lines of a source of voltage.

8. A system according to Claim 6 or Claim 7 wherein at least one of the sources of light comprises two lamps of the same colour with which there is associated a switch whereby said lamps may be connected at will in series or parallel.

9. A system according to Claim 6 or Claim 7 or Claim 8 having control means common to all of said switches so arranged that selected ones of the switches may be actuated in a predetermined manner by adjustment of said control means.

10. A colour lighting system according to any of the preceding claims comprising an electrical switching arrangement having a plurality of switches whereby selected light sources may be connected at will in series or in parallel or in a series parallel arrangement and an adjustable actuating member common to all of said switches for operating them selectively in a predetermined manner.

11. A colour lighting system arranged and adapted to operate substantially as described with reference to Figure 1 or Figure 2 or Figure 3 of the accompanying drawings.

12. A colour lighting system having control means arranged and adapted to operate substantially as described with reference to Figure 4 or Figures 5 and 8 or Figure 6 or Figure 7 of the accompanying drawings.

13. In a colour lighting system, the method of selecting and connecting a plurality of electrical sources of light of different colours to produce a desired hue of colour substantially as described with reference to the accompanying drawings.

ERIC POTTER AND CLARKSON,
Chartered Patent Agents.

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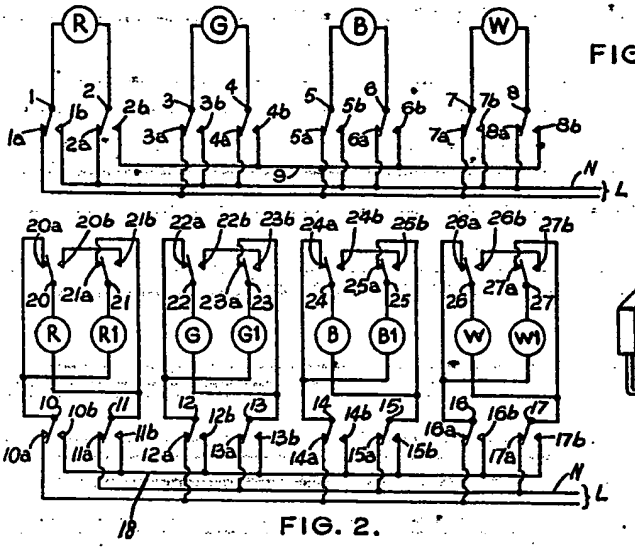

FIG. 1.

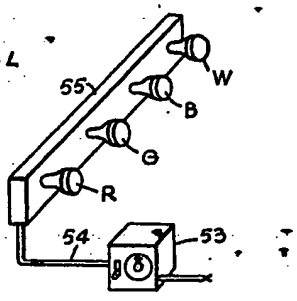

FIG. 5.

FIG. 2.

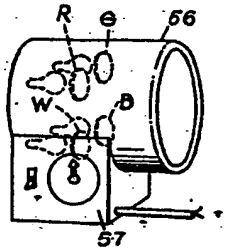

FIG. 6.

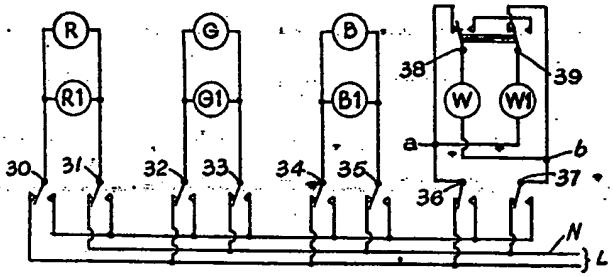

FIG. 3.

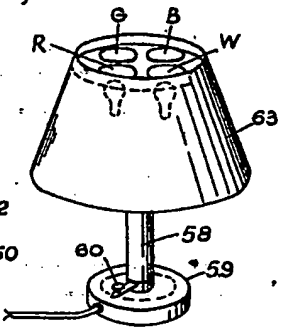

FIG. 7.

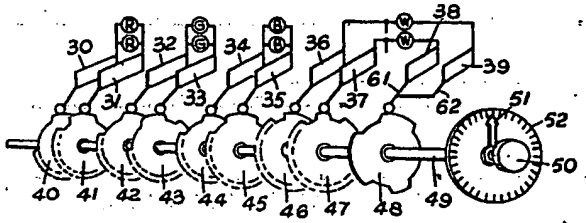

FIG. 4.

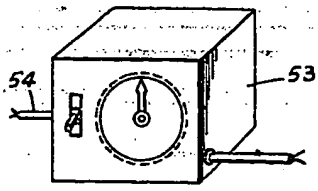

FIG. 8.

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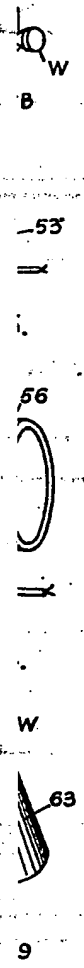
SHEETS 1 & 2



% Total Load	No.	Final Color Mixture	Micro-Switch Operation (Fig. 3)									Lamp Voltages					% Output of Light Sources			
			30	31	32	33	34	35	36	37	38	R	G	B	W	W1	R	G	B	W
25	1	Blue	X	X	X	X	-	-	X	X	X	-	-	118	-	-	-	-	100	-
44	2	Deep Cerise	-	X	X	-	-	-	X	X	X	59	59	118	-	-	7	7	100	-
46	3	Cerise	-	X	X	-	-	-	X	-	X	75	43	118	21·5	21·5	20	1·2	100	-
48	4	Mauve	-	X	X	-	-	-	X	-	-	92	26	118	26	26	40	-	100	-
50	5	Magenta	-	-	X	-	-	-	X	X	X	118	-	118	-	-	100	-	100	-
60	6	Deep Pink	-	-	X	-	-	-	-	X	X	118	12	118	53	53	100	-	100	4·7
71	7	Pink	-	-	X	-	-	-	-	X	-	118	59	118	59	59	100	7	100	7
75	8	Flesh White	-	-	X	X	-	-	-	-	-	118	-	118	118	118	100	-	100	100
50	9	Warm White	-	-	-	X	-	X	-	-	-	118	-	-	118	118	100	-	-	100
47	10	Gold	-	-	-	X	-	X	X	-	-	118	26	26	92	92	100	-	-	40
43	11	Copper	-	-	-	X	X	X	X	-	-	118	59	-	59	59	100	7	-	7
34	12	Flame	-	-	-	X	X	X	X	-	X	118	12	-	53	53	100	-	-	4·7
43	13	Orange	-	-	-	X	X	-	X	X	X	118	59	59	-	-	100	7	7	-
25	14	Red	-	-	-	X	X	X	X	X	X	118	-	-	-	-	100	-	-	-
44	15	Orange	-	-	-	X	X	-	X	-	X	118	75	43	21·5	21·5	100	20	1·2	-
47	16	Yellow	-	-	-	X	X	-	X	-	-	118	92	26	26	26	100	40	-	-
43	17	Deep Gold	-	-	-	X	X	X	X	-	-	118	59	-	59	59	100	7	-	7
47	18	Gold	-	-	-	X	-	X	X	-	-	118	26	26	92	92	100	-	-	40
50	19	Warm White	-	-	-	X	-	X	-	-	-	118	-	-	118	118	100	-	-	100
75	20	Gold White	-	-	-	-	X	X	-	-	-	118	118	-	118	118	100	100	-	100
50	21	Green White	-	X	-	-	-	X	-	-	-	-	118	-	118	118	-	100	-	100
46	22	Pale Lime	-	X	-	-	-	X	X	-	-	26	118	26	92	92	-	100	-	40
43	23	Pale Green	-	X	-	-	X	X	X	-	-	59	118	-	59	59	7	100	-	7
34	24	Deep Green	-	X	-	-	X	X	X	-	X	12	118	-	53	53	-	100	-	4·7
46	25	Apple Green	-	X	-	-	X	-	X	-	X	75	118	43	21·5	21·5	20	100	1·2	-
43	26	Deep Lime	-	X	-	-	X	-	X	X	X	59	118	59	-	-	7	100	7	-
25	27	Green	X	X	-	-	X	-	X	X	X	-	118	-	-	-	-	100	-	-
43	28	Bluish Green	-	X	-	-	X	-	X	X	X	59	118	59	-	-	7	100	7	-
46	29	Peacock	-	X	-	-	X	-	-	X	X	43	118	75	21·5	21·5	1·2	100	20	-
47	30	Deep Turquoise	-	X	-	-	X	-	-	X	-	25	118	92	26	26	-	100	40	-
50	31	Turquoise	-	X	-	-	-	-	X	X	X	-	118	118	-	-	-	100	100	-
59	32	Pale Turquoise	-	X	-	-	-	-	X	-	X	12	118	118	53	53	-	100	100	4·7
68	33	Sky Blue	-	X	-	-	-	-	X	-	-	59	118	118	59	59	7	100	100	7
46	34	Blue White	-	X	-	X	-	-	X	-	-	26	26	118	92	92	-	-	100	40
50	35	Cold White	-	X	-	X	-	-	-	-	-	-	-	118	118	118	-	-	100	100
46	36	Blue White	-	X	-	X	-	-	X	-	-	26	26	118	92	92	-	-	100	40
44	37	Pale Violet	X	X	-	X	-	-	X	-	-	-	59	118	59	59	-	7	100	7
34	38	Lavender	X	X	-	X	-	-	X	-	X	-	12	118	53	53	-	-	100	1·2

FIG. 9.

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2 SHEETS
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SHEETS 1 & 2

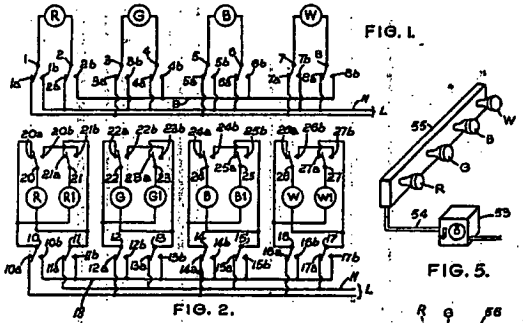

FIG. 1.

FIG. 2.

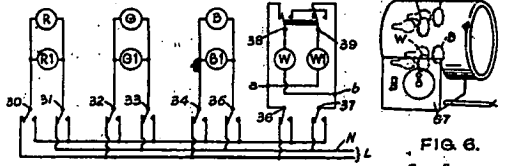

FIG. 3.

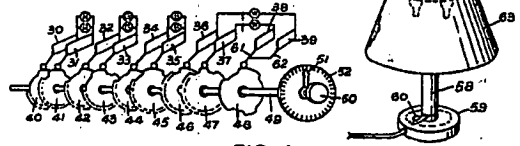

FIG. 4.

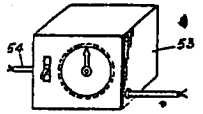

FIG. 8.

FIG. 5.

FIG. 6.

FIG. 7.

Load Sq.	No.	Final Color Mixture	Micro-Switch Operation (Fig. 3)								Lamp Voltages					% Output of Light Sources			
			30	31	32	33	34	35	36	37	38	R	G	B	W	W1	R	G	B	W
25	1	Blue	X	X	X	X	-	-	X	X	X	-	-	118	-	-	-	-	100	-
44	2	Deep Cerise	-	X	X	-	-	-	X	X	X	59	59	118	-	-	7	7	100	-
46	3	Cerise	-	X	X	-	-	-	X	-	X	75	43	118	215	215	20	1·2	100	-
48	4	Mauve	-	X	X	-	-	-	X	-	-	92	26	118	26	26	40	-	100	-
50	5	Magenta	-	-	X	-	-	-	X	X	X	118	-	118	-	-	100	-	100	-
60	6	Deep Pink	-	-	X	-	-	-	-	X	X	118	12	118	53	53	100	-	100	4·7
71	7	Pink	-	-	X	-	-	-	-	X	-	118	59	118	59	59	100	7	100	7
75	8	Flesh White	-	-	X	X	-	-	-	-	-	118	-	118	118	118	100	-	100	100
50	9	Warm White	-	-	-	X	-	X	-	-	-	118	-	-	118	118	100	-	-	100
47	10	Gold	-	-	-	X	-	X	X	-	-	118	26	26	92	92	100	-	-	40
43	11	Copper	-	-	-	X	X	X	X	-	-	118	59	-	59	59	100	7	-	7
34	12	Flame	-	-	-	X	X	X	X	-	X	118	12	-	53	53	100	-	-	4·7
45	13	Orange	-	-	-	X	X	-	X	X	X	118	59	59	-	-	100	7	7	-
25	14	Red	-	-	-	X	X	X	X	X	X	118	-	-	-	-	100	-	-	-
44	15	Orange	-	-	-	X	X	-	X	-	X	118	75	43	215	215	100	20	1·2	-
47	16	Yellow	-	-	-	X	X	-	X	-	-	118	92	26	26	26	100	40	-	-
43	17	Deep Gold	-	-	-	X	X	X	X	-	-	118	59	-	59	59	100	7	-	7
47	18	Gold	-	-	-	X	-	X	X	-	-	118	26	26	92	92	100	-	-	40
50	19	Warm White	-	-	-	X	-	X	-	-	-	118	-	-	118	118	100	-	-	100
75	20	Gold White	-	-	-	-	X	X	-	-	-	118	118	-	118	118	100	100	-	100
50	21	Green White	-	X	-	-	-	X	-	-	-	-	118	-	118	118	-	100	-	100
46	22	Pale Lime	-	X	-	-	-	X	X	-	-	26	118	26	92	92	-	100	-	40
43	23	Pale Green	-	X	-	-	X	X	X	-	-	59	118	-	59	59	7	100	-	7
34	24	Deep Green	-	X	-	-	X	X	X	-	X	12	118	-	53	53	-	100	-	4·7
46	25	Apple Green	-	X	-	-	X	-	X	-	X	75	118	43	215	215	20	100	1·2	-
45	26	Deep Lime	-	X	-	-	X	-	X	X	X	59	118	59	-	-	7	100	7	-
25	27	Green	X	X	-	-	X	-	X	X	X	-	118	-	-	-	-	100	-	-
43	28	Bluish Green	-	X	-	-	X	-	X	X	X	59	118	59	-	-	7	100	7	-
46	29	Peacock	-	X	-	-	X	-	-	X	X	43	118	75	215	215	1·2	100	20	-
47	30	Deep Turquoise	-	X	-	-	X	-	-	X	-	25	118	92	26	26	-	100	40	-
50	31	Turquoise	-	X	-	-	-	-	X	X	X	-	118	118	-	-	-	100	100	-
59	32	Pale Turquoise	-	X	-	-	-	-	X	-	X	12	118	118	53	53	-	100	100	4·7
68	33	Sky Blue	-	X	-	-	-	-	X	-	-	59	118	118	59	59	7	100	100	7
46	34	Blue White	-	X	-	X	-	-	X	-	-	26	26	118	92	92	-	-	100	40
50	35	Cold White	-	X	-	X	-	-	-	-	-	-	-	118	118	118	-	-	100	100
46	36	Blue White	-	X	-	X	-	-	X	-	-	26	26	118	92	92	-	-	100	40
44	37	Pale Violet	X	X	-	X	-	-	X	-	-	-	59	118	59	59	-	7	100	7
34	38	Lavender	X	X	-	X	-	-	X	-	X	-	12	118	53	53	-	-	100	1·2

FIG. 9.